

Prebiotic Molecules and the Chemistry of Nitrile Ices: Possible Applications to Titan and Other Objects

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Ices of the Solar System and the interstellar medium are processed by energy sources, such as cosmic rays and far-UV photons, to generate a variety of molecules, including complex organics. These molecules may contribute to the chemical properties of present-day objects, and may have been delivered by comets to the ancient Earth, serving as an early source of prebiotic organics.

In the Cosmic Ice Laboratory at the Goddard Space Flight Center we study the energetic processing of ices by carrying out proton irradiations and far-UV photolyses of samples containing water-ice and simple organic molecules. Experiments have been done with both pure and mixed-molecular ices at 10 - 100 K under high vacuum, irradiating with ~ 1 MeV protons, to simulate cosmic-ray bombardment, and monitoring the induced reactions via IR spectroscopy. Residues left after subsequent warming of processed ices to room temperature have been analyzed chromatographically to study the thermal and radiation stability of the starting materials, and to search for compounds of possible prebiotic significance. Our experiments have been adjusted to probe the solid-phase chemistry of ices on Titan, which is of particular relevance to this meeting since Titan can be viewed as an astrobiological laboratory.

In this presentation, we will focus on ices containing nitriles, such as those observed on Titan, in cometary comae, and in the interstellar medium. Recent results will be presented and predictions made. This work is being done through the Goddard Center for Astrobiology.